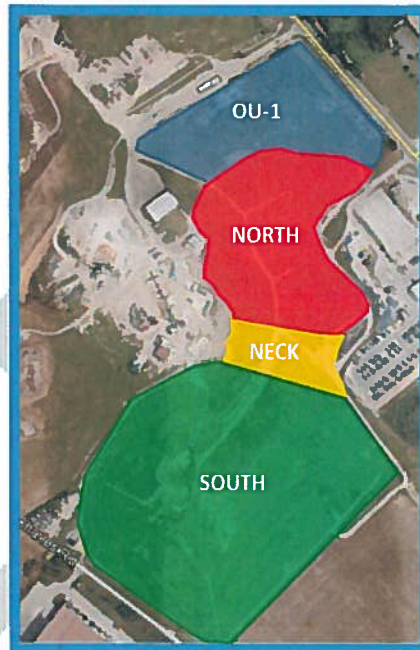


Bridgeton Landfill Data Review Update

Reflects Documents Published on MDNR's Webpage Through 26 November 2013

Introductory Remarks

The ORD Engineering Technical Support Center (ETSC) and their subcontractor, Innovative Waste Consulting Services, LLC (IWCS), reviewed available data and reports on the Bridgeton Landfill available at the [Missouri DNR's Bridgeton Landfill website](#). The purpose of the review was to examine available data from within the landfill (gas extraction wells (GEWs), gas interceptor wells (GIWs), and temperature monitoring probes (TMPs)) and assess the presence and movement of any subsurface oxidation event/heat generating events occurring in the South (~35 acre) or North (~15 acre) cells, or the adjoining "neck" area between these cells in the landfill.



The landfill cells were closed with a 2-ft thick clay cap (with specified hydraulic conductivity $<1 \times 10^{-5}$ cm/sec) overlain by a 1-ft thick vegetative soil layer. The closure of the South and North cells was approved by MDNR in 2008 and 2010, respectively. To aid in landfill gas collection efficiency and help control odors, an Ethylene Vinyl Alcohol (EVOH) flexible membrane liner (FML) cap was placed over 32 acres in the South cell area and substantially completed in August 2013. An additional 10 acres of EVOH liner was placed on other portions of the South cell and neck area, which was completed in late October 2013. Installation of an EVOH cap for the North cell was approved in the North Quarry Action Plan, revised in November 2013. Installation of the EVOH cap in the North cell is anticipated to begin in early 2014. The total area proposed for the EVOH cap in the North Quarry is approximately 21.1 acres.

North Cell

Temperature

- November 2013 temperature measurements in the GEWs in this area show nearly no change or slightly decreasing levels compared to October 2013. This observation may be attributed to the vacuum pressure being substantially decreased over time at most wells in the North Cell. Throughout November 2013, only six of 24 wells had an applied vacuum greater than 2" water column. When a limited vacuum is applied, the measured temperature becomes a function of both the landfill gas and ambient conditions, since a limited amount of gas is being pulled through the well.

Collected Gas Quality

- Gas quality in the North cell GEWs shows CH₄ and CO₂ concentrations indicative of anaerobic decomposition conditions. However, in November 2013, 17 out of 24 wells in the North Cell had measured "balance" gas (a value calculated by the landfill gas monitoring device, defined as the percentage of gas that is not CH₄, CO₂, or O₂)

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concentrations of greater than 10% - none of these wells had measurable O₂ concentrations. High balance gas concentrations are often coupled with elevated O₂ concentrations, and if atmospheric air is being pulled into the well (e.g., through a crack in the gas well head) the proportion will usually be about 4 parts balance to 1 part O₂ (consistent with the proportion of N₂ and O₂ in the atmosphere). However, if the balance gas is something other than N₂ or if atmospheric air is being pulled into the waste and consumed, the resultant gas would have an elevated balance reading and a low O₂ reading. Given the limited data, the latter scenario could be happening. Laboratory analysis that could be used to confirm the nature of the "balance" gas was conducted once for the North Cell wells in June 2013, but not since.

- Strong trends from recently-collected data are difficult to assess because the valves on many wells are closed or nearly closed, which is reflected in the low measured vacuum in most wells. Most wells had a vacuum of less than 1" of water column and many were at or near 0" of water column.
 - Only six wells have recently recorded vacuum pressure of more than 2 inches of water column.
 - GEW-45R: 2.8" to 3.6"
 - GEW-50: 2.1"-5.9" (consistent around 2")
 - GEW-07: 2.4"-3.6" (since April 2013)
 - GEW-54: 2"-3"
 - GEW-08: 2.3"-4.7"
 - GEW-09: 2.1"-2.5"
- Wells showing the highest "balance" gas concentrations were generally located in the northern portion of the cell, and included the northern-most row of wells:
 - GEW-02
 - GEW-03
 - GEW-04
 - GEW-05

Settlement

- No settlement data were collected for the North cell by the landfill operators, so no assessment was made.

Neck Area

Temperature

- Data from November 2012 through November 2013 demonstrate that several TMPs exhibited continued gradual increases in temperature at different depths over time, including the two most northerly TMPs (TMP-1 and TMP-2). Temperatures at all depths in TMP-1 and all but two depths in TMP-2 (0 ft and 200 ft) increased in November 2013 compared to October 2013. Most of the temperature increases were less than 5 °F.
- Some TMPs in the Neck have shown temperature increases ranging from 10-25 °F in the last 45 days at one or more depths:
 - TMP-3
 - TMP-5
 - TMP-6

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- TMP-9
- TMP-12
- In November 2013, four of the 13 wells in the GIW system showed increasing temperature trends, two (2) wells demonstrated unchanged temperatures and the remaining wells showed slightly decreasing temperature readings. One of the wells (GIW-11, in the northernmost row of GIWs) showed a 15 °F increase in temperature in November.
- The northern-most well in the neck (GEW-10) has mostly been closed since July 2013 and temperatures have declined. The temperature in the other northern-most well (GEW-39) has a slight vacuum placed on it and temperature has been steady (limited change) in the previous three months. GEW-56R, which is centrally located in the Neck, has had steady or slightly declining temperature since it was shut off in the August-September timeframe. Strong trends are difficult to assess in the GEWs located in the Neck because of the state of the valve position (e.g., if the valve is closed, it is not possible to determine if temperature measured is representative of that within the landfill at that point or if it was impacted by ambient air temperature).

Collected Gas Quality

- Three of five GEWs (-09, -56R, -109) in the neck area exhibited increasing concentrations of balance gas ranging from 10 to 40%, which is not indicative of dominant anaerobic decomposition conditions. These wells exhibited low or decreasing levels of CH₄ throughout November:
 - GEW-09 between 30-40%:
 - GEW-56R < 20%
 - GEW-109 < 10%.
- CO₂ levels at GEW-56R and -109 ranged from 60-70%, which are higher than that observed during normal anaerobic waste decomposition. These gas concentrations could be a reflection of actual waste conditions near the well or off-gas from the reaction occurring in the South cell.
- Strong trends in the laboratory data were not observed regarding CO concentrations. This could be the result of the valve position described previously, where many wells appeared to be nearly closed. Two wells exhibited H₂ concentrations greater than 10% in November 2013:
 - GEW-109 = 32%
 - GEW-110 = 12%
- Other wells (GEW-39 and -56R) had CO concentrations > 2%. Laboratory analysis in GEW-109 and -110 suggest some intrusion of atmospheric air based on an approximately 3:1 to 4:1 ratio of N₂ to O₂.

Settlement

No settlement data were available for the neck area.

South Cell

Temperature

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Temperatures in most GEWs were in the 140 °F to 200 °F range. A total of 18 GEWs in the South cell were closed (based on pressure readings) and exhibited temperatures <100 °F (approximately 18 GEWs, where inconsistent gas quality in these GEWs was observed).

Collected Gas Quality

- Low CH₄ readings (generally <5%) were observed in the majority of wells. In November, no South Area GEWs exhibited gas concentrations consistent with anaerobic waste decomposition (i.e., approximately 50% CH₄ and CO₂).
- The majority of CO₂ levels were within the 60-90% range.
- Balance gas was generally 15-40%, and in several GEWs 60-75% balance gas was observed over multiple monitoring events. O₂ levels were generally at or near 0%; however, select wells exhibited O₂ levels in the 10-20% range (8 GEWs in November), indicative of atmospheric air intrusion.

Settlement

- Settlement data (i.e., elevation changes at established points), from late June through mid-November, appear to show generally spatially consistent rates of settlement over time.
- The largest areas of settlement are located in the southern-central portion of the South cell. A smaller, less-pronounced settlement area is present to the south of the Neck area.
- Settlement shown in the contour maps represented elevation changes spanning different time periods, so direct comparison of a settlement rate from one map to another was inhibited.
- In the settlement maps that were analyzed, points where a positive elevation change occurred were filtered out, so the settlement rates should be interpreted with caution. For example, if an area settled and was subsequently filled in, that settlement would not be captured in the map. It is unknown whether or not the operator is cutting open the EVOH cap to repair instances of localized settlement.

